Why Would Consumers Benefit from a Variable Resource Requirement?

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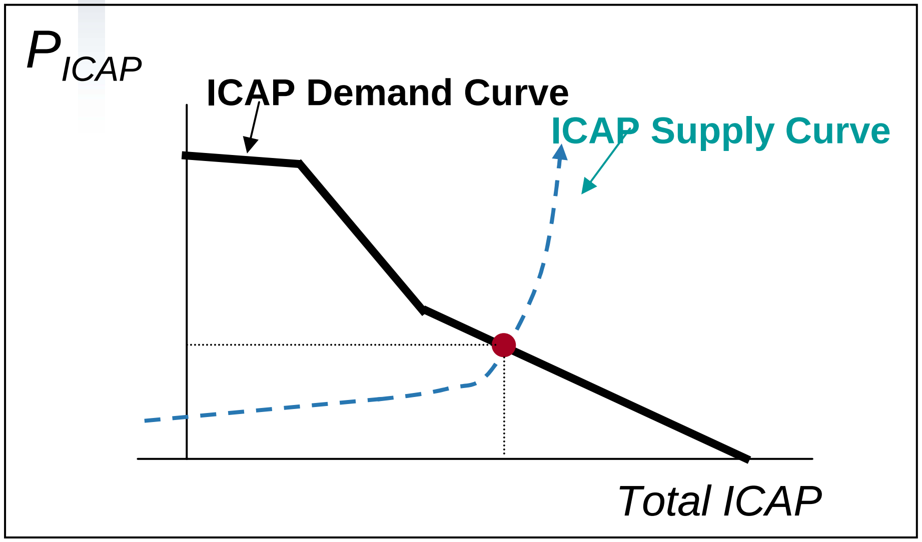
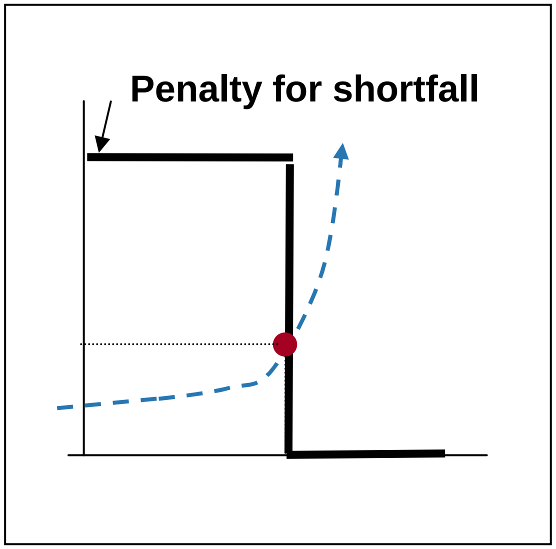
VRR: Demand Curves for Capacity

Payment from ISO depends on reserve margin ….





…. instead of fixed requirement & penalty for falling short ("vertical demand")

Hypothesized benefit of a VRR: Less volatile revenues

$\Rightarrow$ lower cost of capital, more willingness to enter market

$\Rightarrow$ lower consumer costs

Overview of Dynamic Analysis: Questions

1. How do different curves affect….
   - *Stability of capacity market?*
   - *Costs to consumers?*
   - *Ability to meet reserve requirement, reliability criterion?*

2. How robust are these conclusions to different assumptions about:
   - *Generator behavior?*
   - *Demand curve parameters?*

Dynamic Analysis: Basic Assumptions

- Capacity additions are a dynamic process. Investment depends on:
  1. *Forecast profits*
     - Based on capacity and energy prices from recent auctions

     More forecast profit ⇨ more investment
  2. *Profit variability*
     - Variations due to forecast error and weather

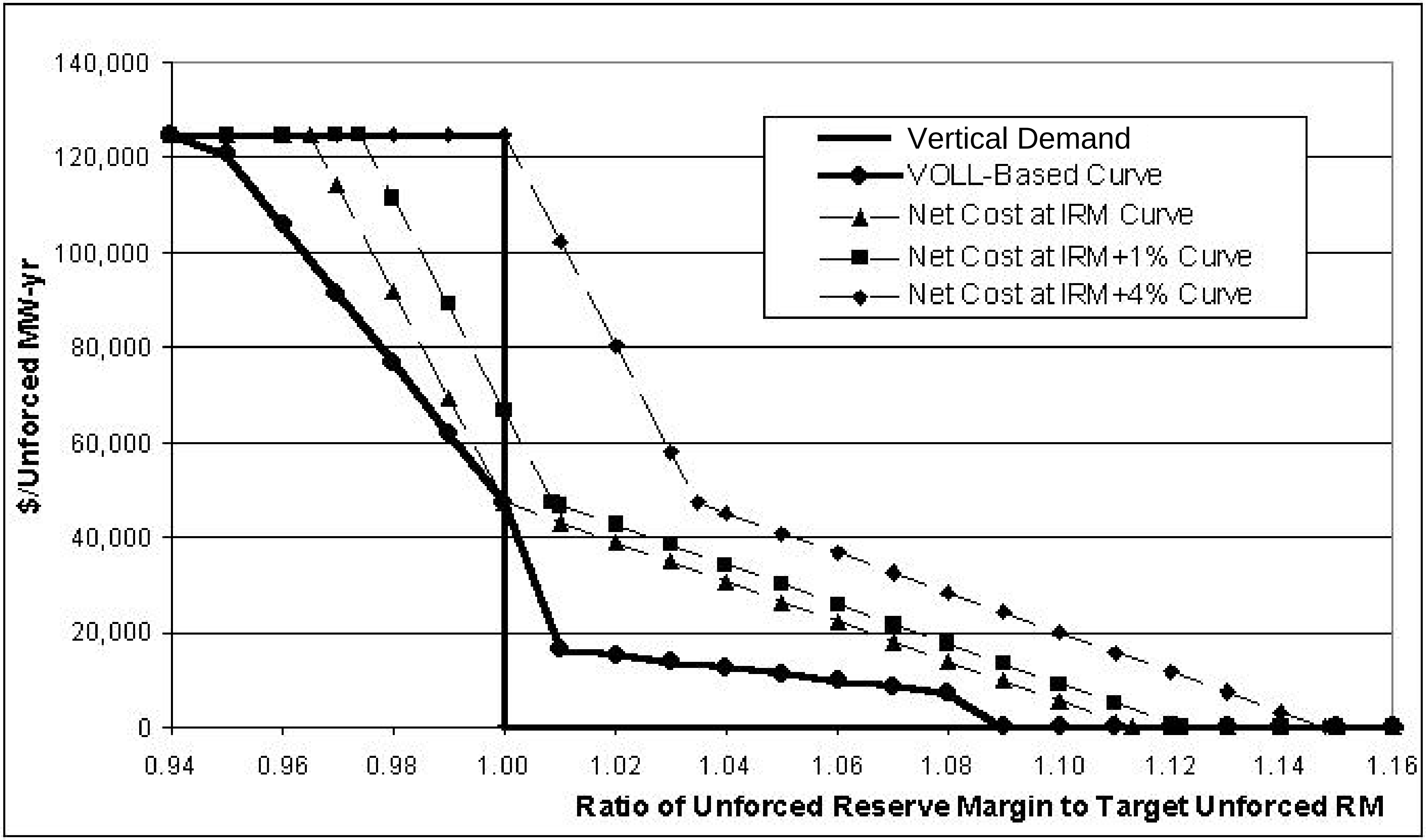
     Highly variable energy and capacity prices ⇨less investment (due to risk aversion)
  3. *Risk attitudes*:
     - No hedges (incomplete market)
     - Risk aversion
     - Short-sightedness

- Random shocks (weather, economic fluctuations) cause variation in returns
  - Result: boom/bust cycles in investment

Dynamic Analysis Model Overview

1. Simple & transparent dynamic model simulates:
   - annual construction of turbine capacity,
   - revenues from energy, ancillary services, & capacity markets,
   - market stability,
   - consumer costs
2. Allows exploration of assumptions
3. The model assesses profitability of CTs needed to meet the reliability requirement.
   - Other types of generation and their profitability not modeled
   - “Representative Agent” approach

Example Analysis: Five Curves Considered

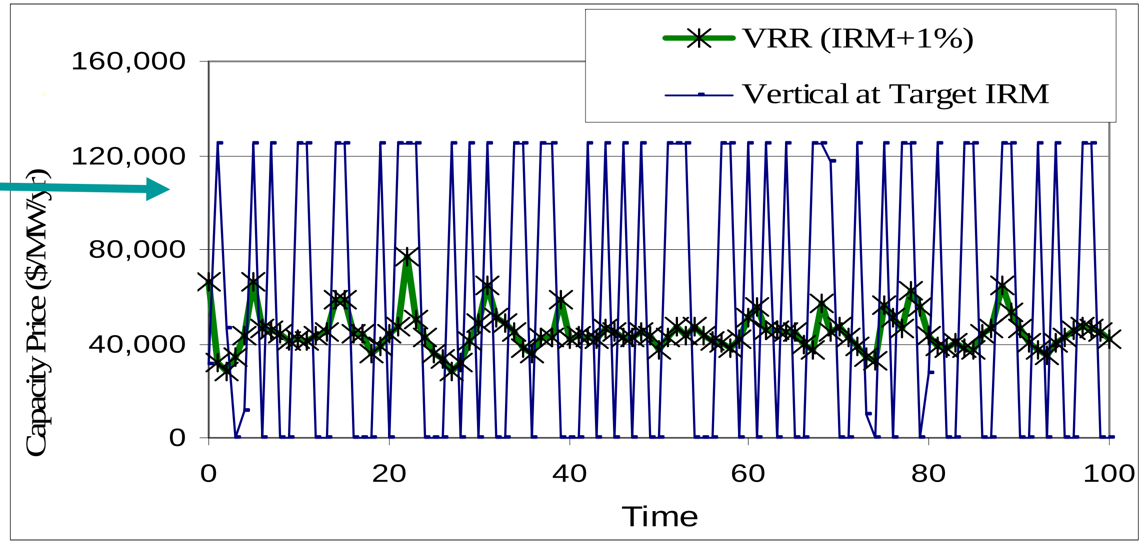


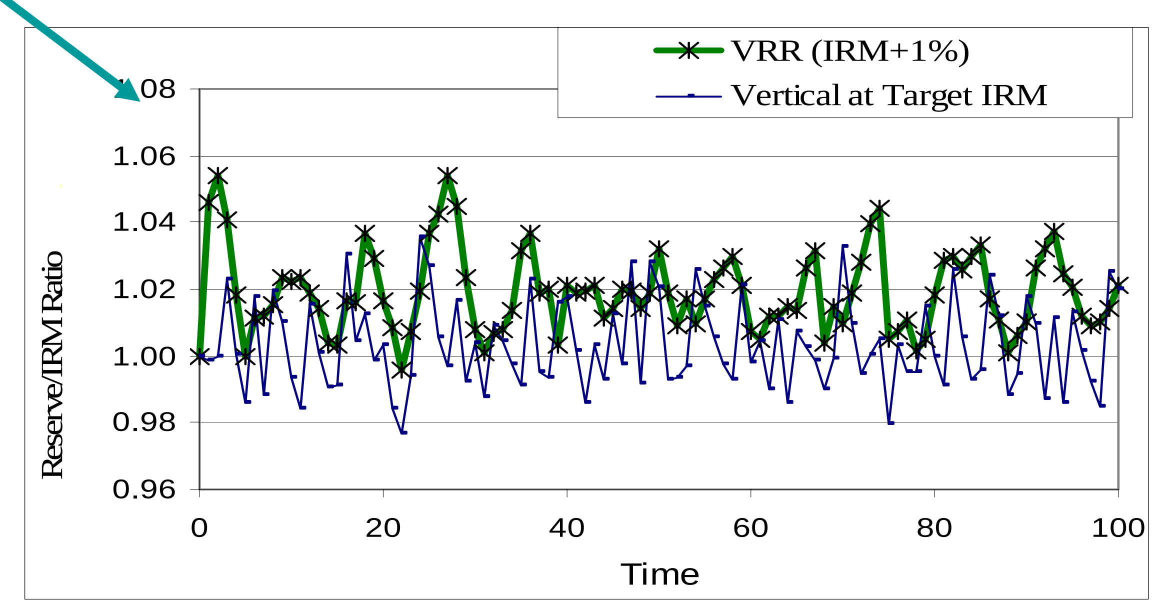
Note: Example only illustrates methodology and does not necessarily represent PJM VRR proposal or conclusions

Results: Summary

1. Sloped curve ("VRR") stabilizes capacity payments
2. More stable payments even out investment, forecast reserves
3. More stable revenues lowers capital costs. Consumer costs (capacity, scarcity) fall:
   - *$99/peak kW/yr for vertical*
   - *$71/peak kW/yr for VRR*

   (values depend on assumptions)
4. Results robust to assumptions





Sample Results: Average (std dev)

(Risk aversion parameter = 0.6; Results depend on assumptions, differ from "base case" results from PJM stakeholder meetings)

Case	% Years meet or Exceed IRM	Average % Reserve over IRM	Generation Profit $/kW-yr {ROE}	Scarcity Rev. $/kW-yr	E&AS Revenue $/kW-yr	ICAP Payment $/kW-yr	Scarcity + ICAP Payment by Consumers (Peak Ld Basis)
1. Vertical Demand	**53**	**0.25 (1.34)**	**37{25%} (98)**	**36 (69)**	**10**	**53 (57)**	**99 (106)**
2. Original PJM Curve, Based on VOLL	**61**	**0.18 (0.65)**	**21{20%} (70)**	**35 (67)**	**10**	**37 (13)**	**80 (74)**
3. Alternate Curve with New Entry Net Cost at IRM	**90**	**1.30 (1.06)**	**13{17%} (52)**	**25 (51)**	**10**	**40 (5)**	**73 (55)**
4. Alternate Curve with New Entry Net Cost at IRM + 1%	**98**	**1.90 (1.07)**	**11{15%} (45)**	**21 (43)**	**10**	**42 (6)**	**71 (47)**
5. Alternate Curve with New Entry Net Cost at IRM + 4%	**100**	**4.04 (1.37)**	**6{13%} (28)**	**11 (23)**	**10**	**47 (11)**	**67 (29)**

⇒ Alternate (sloped) curves have lower consumer cost and better adequacy

Advantages of Sloped Demand ("VRR")

- **Advantages of VRR:**
  - **VRR logically reflects reality of capacity value:**
    - ***Marginal value of capacity not zero even if there are extra reserves***
    - ***If reserves are short, payments should be higher***
  - **Compared to vertical demand, VRR lowers risk to generators. Result:**
    - ***Lower required return to capital***
    - ***More investment in generation***
    - ***Dampened capacity cycles***
    - ***Lower consumer cost***
  - **Elasticity mitigates market power in capacity market**

Biography

B.F. Hobbs is a Professor in the Department of Geography & Environmental Engineering of The Whiting School of Engineering, Johns Hopkins University, Baltimore, MD. He also holds a joint appointment with the Department of Applied Mathematics & Statistics.

Previously, he was Professor of Systems Engineering and Civil Engineering at Case Western Reserve University, and Wigner Fellow at Oak Ridge National Laboratory. He is a member of the California ISO Market Surveillance Committee, as well as Scientific Advisor to the Policy Studies Unit, Energieonderzoek Centrum Nederlands (ECN) and member of the GTI Public Interest Advisory Committee. From 1985-1995, he was on the Case Western Reserve University faculty of engineering, and he has also been a researcher at Oak Ridge National Laboratory and Brookhaven National Laboratory. He has served as consultant to a number of private and public sector clients in the energy industry, including the FERC Office of the Economic Advisor (1996-2002).

His Ph.D. is in Environmental Systems Engineering from Cornell University, and he has published widely on electric power system economics, market power, and modeling.